

Precision Orchard Management: Research Update part 2



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Weather-based decision support tools

1. Improved irrigation scheduling tool
2. Apple carbohydrate model (thinning response)
3. Tart cherry bloom prediction
4. Peach fruit development model

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#1 – Irrigation scheduling

- WSU Irrigation Scheduler Mobile

irrigation scheduler mobile

Add New Field [Help](#)

Check box to start with existing field:

Name: Kaysville nc140 tarts

Year: 2017

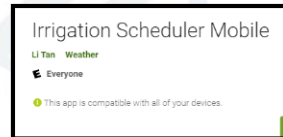
Network: Select Network

Station: Select Network

Crop: AgWeatherNet (WA,OR)
AgriMet (WA,OR,ID,NV,MT)
CoAgMet (CO)

Soil: AZMET (AZ)
NDAWN (ND)
AWDN (SD)
CIMIS (CA)
Agrimet (MT)
Alberta (Alberta, CA)
CEMP (AW)
UCC - AGWYX (UT,WY,NM,ID,HI,CO)
UCC - FGNET (UT,WY,NM,ID,HI,CO)
UCC - UAGRIMET (UT,WY,NM,ID,HI,CO)
UCC - UCRN (UT)
UCC - USCAN (UT)
WACNet (Wyoming)

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#2 Apple Carbohydrate Model

- Carbon balance affects thinning response
- Surplus = difficult to thin
- Deficit = easy to thin

Table 1. Decision rules for using the output of the carbohydrate model to adjust rate.

| 4-day Av. Carb. Balance | Thinning Recommendation |
|-------------------------|---------------------------------------------------|
| +20g/day to 0g/day | Increase Chemical Thinning Rate by 30% |
| 0g/day to -20g/day | Apply Standard Chemical Thinning Rate |
| -20g/day to -40g/day | Decrease Chemical Thinning Rate by 10% |
| -40g/day to -60 g/day | Decrease Chemical Thinning Rate by 20% |
| -60g/day to -80 g/day | Decrease Chemical Thinning Rate by 30% |
| < than -80g/day | Do not thin (many fruits will fall off naturally) |

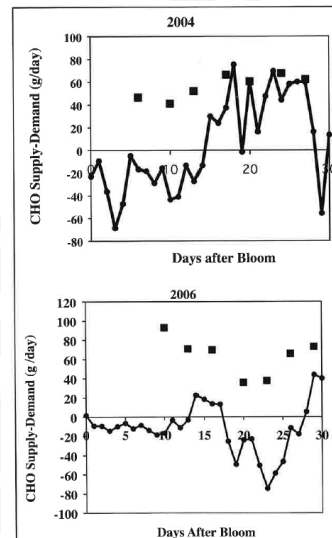


Fig. 3. Predicted daily carbohydrate balance (line) at Geneva, NY in 2004 and 2006 and results of timing trials of thinning as % of the crop load on unthinned trees (square data points).

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#2 – Carbo thinning

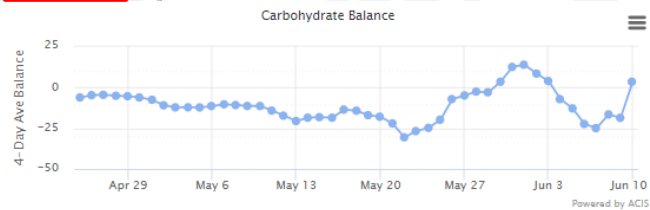
Annual fee per state
UDAF grant will cover 2020, 2021

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#2 – Carbo thinning

| Date | Max Temp (°F) | Min Temp (°F) | Solar Rad (MJ/m ²) | Tree Carbohydrate Status (g/day) | | | Thinning Recommendation |
|------|---------------|---------------|--------------------------------|----------------------------------|--------|---------|-------------------------|
| | | | | Production | Demand | Balance | |
| 4/23 | 56 | 45 | 16.6 | 0.00 | 10.57 | -10.57 | -6.13 |
| 4/29 | 54 | 39 | 9.4 | 2.09 | 25.02 | -22.92 | -14.79 |
| 5/03 | 54 | 40 | 18.3 | 12.29 | 18.90 | -6.61 | -11.94 |
| 5/11 | 66 | 38 | 25.0 | 17.57 | 28.00 | -10.43 | -22 |
| 5/22 | 67 | 46 | 14.7 | 10.67 | 38.08 | -27.41 | -30.54 |
| 5/23 | 67 | 54 | 26.4 | 20.39 | 47.69 | -27.30 | -26.72 |
| 5/24 | 62 | 48 | 14.1 | 15.20 | 36.05 | -22.85 | -24.74 |
| 5/25 | 80 | 57 | 22.4 | 18.80 | 63.42 | -44.62 | -19.76 |
| 5/26 | 68 | 51 | 26.2 | 30.66 | 42.75 | -12.09 | -7.14 |
| 5/27 | 64 | 48 | 11.1 | 15.96 | 35.36 | -19.40 | -4.91 |
| 5/28 | 65 | 48 | 19.8 | 31.97 | 34.89 | -2.92 | -2.54 |
| 5/29 | 69 | 50 | 27.4 | 44.13 | 38.28 | 5.86 | -2.97 |
| 5/30 | 68 | 54 | 22.7 | 41.41 | 44.59 | -3.19 | 3.51 |
| 5/31 | 79 | 45 | 19.7 | 41.74 | 51.67 | -9.92 | 12.58 |
| 6/1 | 80 | 49 | 13.6 | 35.37 | 40.00 | -4.63 | 13.96 |
| 6/2 | 55 | 45 | 29.0 | 45.70 | 31.94 | 13.76 | 13.76 |
| 6/3 | 59 | 40 | 23.9 | 65.66 | 32.5 | 33.16 | 33.16 |

| Date | Max Temp (°F) | Min Temp (°F) | Solar Rad (MJ/m ²) | Tree Carbohydrate Status (g/day) | | | 4-Day Ave Balance | Thinning Recommendation |
|------|---------------|---------------|--------------------------------|----------------------------------|--------|---------|-------------------|---------------------------------------|
| | | | | Production | Demand | Balance | | |
| 6/4 | 73 | 53 | 23.8 | 64.48 | 68.89 | -4.41 | -7.15 | Apply standard chemical thinner rate |
| 6/5 | 67 | 57 | 13.1 | 43.86 | 70.34 | -26.48 | -12.84 | Apply standard chemical thinner rate |
| 6/6 | 72 | 48 | 28.4 | 81.92 | 68.36 | 13.56 | -22.35 | Decrease chemical thinner rate by 15% |
| 6/7 | 82 | 51 | 28.7 | 81.80 | 93.08 | -11.28 | -24.9 | Decrease chemical thinner rate by 15% |
| 6/8 | 82 | 58 | 28.2 | 82.10 | 109.28 | -27.18 | -16.5 | Apply standard chemical thinner rate |
| 6/9 | 69 | 60 | 7.1 | 26.20 | 90.71 | -64.52 | -18.61 | Apply standard chemical thinner rate |
| 6/10 | 64 | 51 | 16.8 | 71.43 | 68.07 | 3.36 | 3.51 | Increase chemical thinner rate by 15% |
| 6/11 | 72 | 49 | 27.8 | 101.46 | 79.14 | 22.32 | | |
| 6/12 | 64 | 55 | 8.6 | 40.05 | 75.65 | -35.60 | | |
| 6/13 | 60 | 48 | 17.8 | 81.36 | 57.41 | 23.95 | | |



#3 – Bloom prediction, tart cherry

- The Utah Model
 - LaMar Anderson, Schuyler Seeley, '70s & '80s
- Chill units (hours at optimally cold temps)
- Heat units (growing degree hours)

Table 1 - Phenoclimatology values for 'Montmorency' sour cherry

| Stage | Chill units | GDH (°C) |
|-------------------------------|-------------|----------|
| Begin chill unit accumulation | 0 | |
| End chill unit accumulation | 954 | |
| 1. First swelling | | 1,010 |
| 2. Side green | | 1,580 |
| 3. Green tip | | 2,410 |
| 4. Tight cluster | | 3,230 |
| 5. Open cluster | | 3,470 |
| 6. First white | | 3,940 |
| 7. First bloom | | 5,380 |
| 8. Full bloom | | 6,130 |
| 9. Petal fall | | 7,560 |

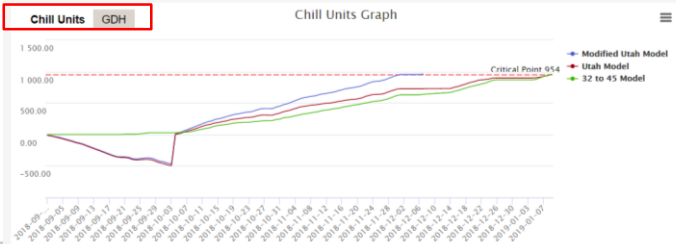
#3 – Bloom prediction, tart cherry

The screenshot shows the Utah State University website with the following elements:

- Header:** Utah State University logo, navigation links (home, A-Z index, calendars, MyUSU, contact, directory), a search bar, and the Utah Climate Center logo.
- URL:** www.climate.usu.edu/fruits
- Navigation:** Home, Climate Data, Research, Plant Management, Utah Agweather, Resources, Login.
- Content Tiles:**
 - Latest Updates:** No Recent Updates.
 - Logan, UT:** 27°F, High: 32°F, Low: 20°F, January 8, 2020, Expires Time Before Freezeback: > 30 Minutes.
 - Downloads:** No downloads are associated with this email from the past 2 weeks.
 - Weather and Pests (Utah TRAPs):** Freeze Dates, Pest concerns? Timing Resource and Alert for Pests can help.
 - Research:** Climate Database Server.
 - Forecast:** (partially visible)

#3 – Bloom prediction, tart cherry

| Date | U. M. Acumm | U. Mod. M. Acumm | 32 To 45 Acumm | Max Temp | Min Temp |
|------------|-------------|------------------|----------------|----------|----------|
| 2018-12-06 | 724 | 951 | 629 | 30 | 22 |
| 2018-12-07 | 724 | 958 | 636 | 35 | 24 |
| 2018-12-08 | 727 | Rest Completed | 643 | 37 | 26 |
| 2018-12-09 | 727 | Rest Completed | 645 | 33 | 27 |
| 2018-12-10 | 728 | Rest Completed | 654 | 37 | 25 |
| 2018-12-11 | 728 | Rest Completed | 654 | 30 | 26 |
| 2018-12-12 | 730 | Rest Completed | 659 | 36 | 25 |
| 2018-12-13 | 730 | Rest Completed | 660 | 33 | 20 |
| 2018-12-14 | 731 | Rest Completed | 666 | 37 | 17 |
| 2018-12-15 | 740 | Rest Completed | 688 | 48 | 33 |



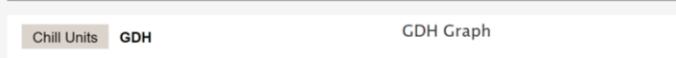
#3 – Bloom prediction, tart cherry

● U. Projections Export

– 3 to 5 day forecast from NWS

← Extended from 30-year average

| Date | Utah GDH | Modified Utah GDH | 32 to 45 GDH | Max Temp | Min Temp |
|---------------------|----------|-------------------|--------------|----------|----------|
| 2020-01-20 | 102 | 186 | 103 | 45 | 24 |
| 2020-01-21 | 32 | 186 | 103 | 43 | 32 |
| 2020-01-22 | 32 | 186 | 103 | 40 | 31 |
| 2020-01-23 Forecast | 33 | 187 | 104 | 42 | 33 |
| 2020-01-24 Forecast | 34 | 188 | 105 | 42 | 31 |
| 2020-01-25 Forecast | 37 | 191 | 108 | 44 | 33 |
| 2020-01-26 Forecast | 46 | 200 | 117 | 45 | 33 |

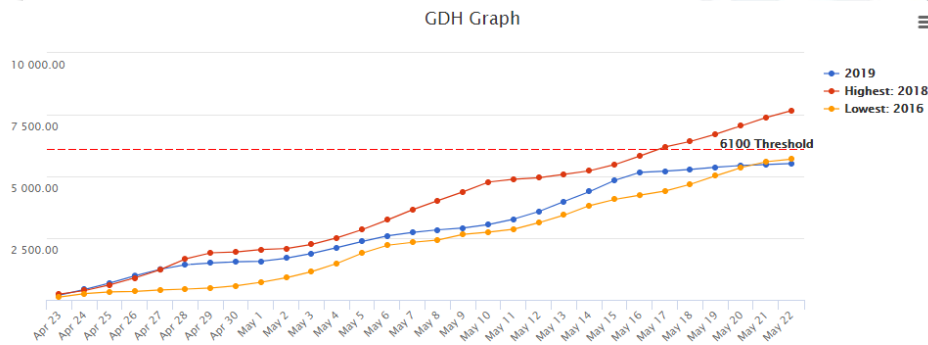


#4 – Peach growth

- High temperatures in first 30 days after bloom
 - Earlier harvest
 - Smaller fruit size potential
- Track heat units for first 30 days (GDH₃₀).
Adjust thinning and crop management on this.
- Threshold is 6100 GDH

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#4 – Peach growth

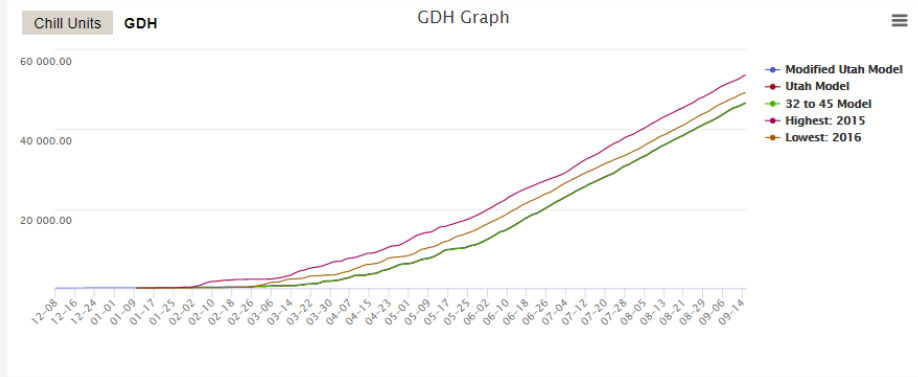


- Current year
- Highest and lowest of past 5

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#4b – Seasonal comparison Beyond GDH-30

- Current year
- Highest and lowest of past 5 or 10 years



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Genetic approaches: Peach rootstocks



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Genetic approaches

Table 2. Rootstock cultivars compared in the 2009 NC-140 trial at three Intermountain West sites and their reported species composition.

| Rootstock cultivar | Species |
|--------------------------------------|--------------------------------------------|
| Lovell | Peach |
| Guardian® | Peach |
| KV-010123 | Peach |
| KV-010127 | Peach |
| Controller™ 8 (HBOK 10) | Peach |
| ¹ Controller™ 7 (HBOK 32) | Peach |
| Bright's Hybrid #5 (BH-5) | Almond x Peach |
| Krymsk® 86 (Kuban 86) | Myrobalan plum x Peach |
| Controller™ 5 (K146-43) | Japanese plum x Peach |
| Atlas | Peach, Almond, Myrobalan and Japanese plum |
| Viking | Peach, Almond, Myrobalan and Japanese plum |
| <i>Prunus americana</i> | American plum |
| Empyrean® 2 (Penta) | European plum |
| ² Imperial California | European plum |
| Rootpac® R (Replantpac) | Myrobalan plum x Almond |
| Krymsk® 1 (VVA-1) | Nanking cherry x Myrobalan plum |

¹Initially included at all three locations, but 100% mortality at UTP.

²Not included in the West Payson location.

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Leaf chlorophyll



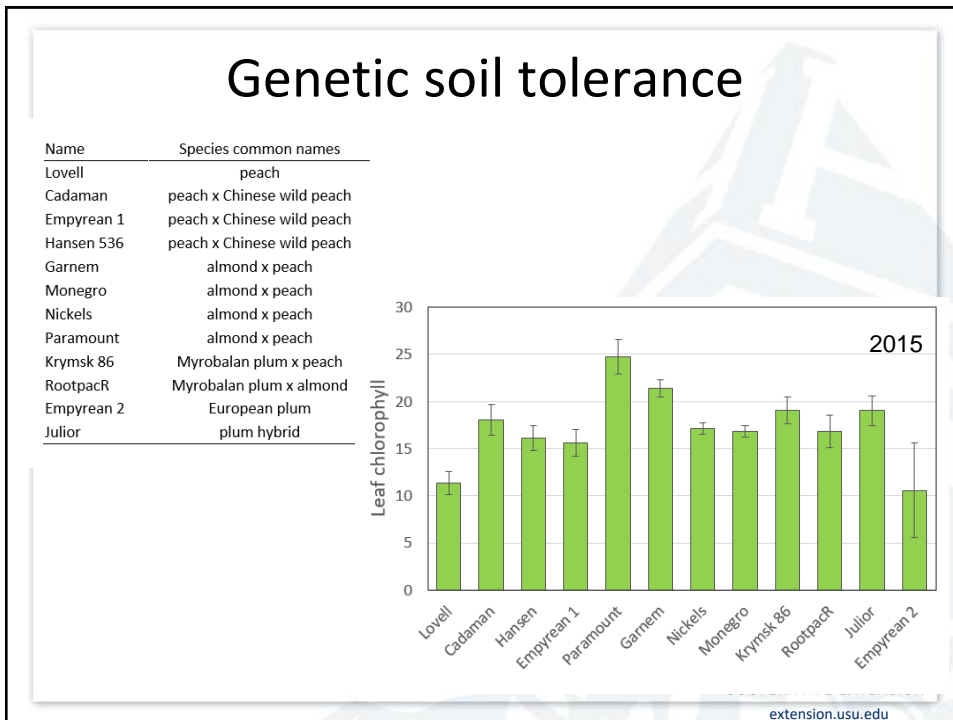
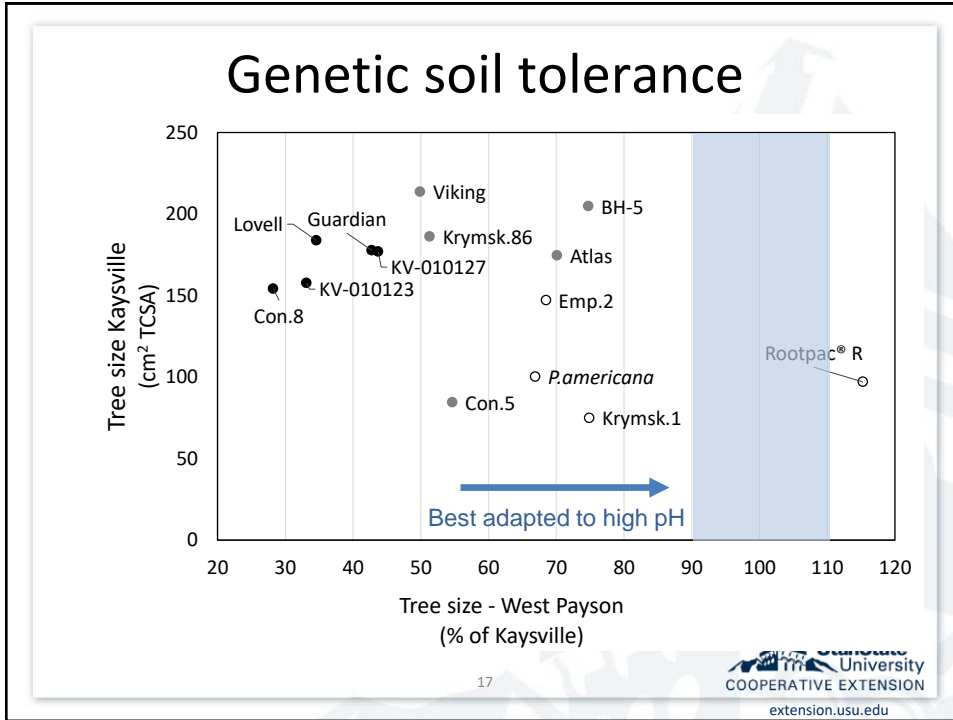
Leaf chlorophyll (CCI, measured 2009-2017), Utah County.

| Rootstock | May | June | July | August | Sept. |
|---------------------|-------------|-------------|-------------|-------------|-------------|
| Br. Hybrid 5 | 17.3 | 16.3 | 17.9 | 22.5 | 22.7 |
| Replantpac® | 16.3 | 17.8 | 17.5 | 22.3 | 21.6 |
| Empyrean®2 | 16.5 | 17.3 | 16.8 | 20.4 | 19.8 |
| Krymsk® 86 | 15.9 | 16.1 | 16.4 | 20.6 | 20.3 |
| Controller™ 5 | 17.5 | 15.1 | 17.1 | 19.8 | 19.8 |
| Atlas | 15.7 | 15.0 | 16.2 | 20.2 | 20.8 |
| Viking | 17.3 | 14.8 | 14.8 | 19.5 | 19.7 |
| Krymsk® 1 | 15.8 | 13.3 | 15.2 | 20.1 | 18.7 |
| <i>P. americana</i> | 14.1 | 15.0 | 15.1 | 18.7 | 18.7 |
| KV010-127 | 14.8 | 12.6 | 13.5 | 17.5 | 19.8 |
| KV010-123 | 12.9 | 11.0 | 13.0 | 15.7 | 15.4 |
| Guardian® | 13.3 | 11.6 | 12.6 | 15.0 | 14.5 |
| Lovell | 13.2 | 11.3 | 11.8 | 14.7 | 14.3 |
| Controller™ 8 | 12.6 | 11.3 | 11.9 | 13.8 | 14.4 |
| Controller™ 7 | -- | -- | -- | -- | -- |

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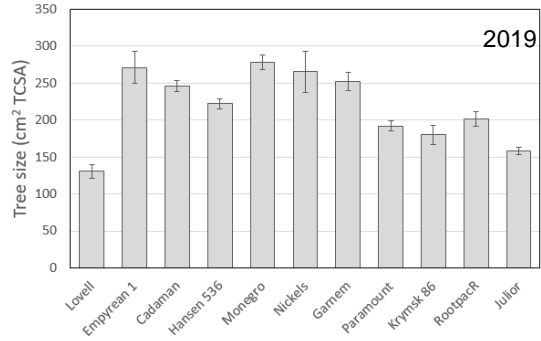
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Genetic soil tolerance

| Name | Species common names |
|------------|----------------------------|
| Lovell | peach |
| Cadaman | peach x Chinese wild peach |
| Empyrean 1 | peach x Chinese wild peach |
| Hansen 536 | peach x Chinese wild peach |
| Garnem | almond x peach |
| Monegro | almond x peach |
| Nickels | almond x peach |
| Paramount | almond x peach |
| Krymsk 86 | Myrobalan plum x peach |
| RootpacR | Myrobalan plum x almond |
| Empyrean 2 | European plum |
| Julior | plum hybrid |



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